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$$\therefore \cos \varphi = \frac{ab}{r\sqrt{(a^2+b^2-r^2)}}, \sin \varphi = \frac{\sqrt{[r^2(a^2+b^2-r^2)-a^2b^2]}}{r\sqrt{(a^2+b^2-r^2)}}.$$

$$\therefore n = \frac{\sqrt{[r^2(a^2+b^2-r^2)-a^2b^2]}}{r\sqrt{(a^2-b^2)}} = \frac{\sqrt{(r^2-b^2)}}{r}.$$

$$\therefore r^2-b^2=r^2n^2, \text{ or } r=\frac{b}{\sqrt{(1-n^2)}}.$$

129. Proposed by B. F. FINKEL, A. M., M. Sc., Professor of Mathematics and Physics in Drury College, Springfield, Mo.

Two spheres whose masses are M_1 and M_2 are a units apart, and attract each other with a force $= M_1 M_2 / a^2$. Find work done in carrying a unit mass from the center point between them a distance r in a direction θ with line of centers.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics in The Temple College, Philadelphia, Pa.

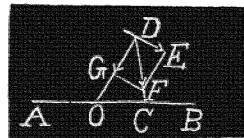
Let $B=m_1$, $A=m_2$, $m_1 > m_2$; C , the centroid of m_1 , m_2 ; $OC=c$, $OD=x$, $DC=y$, $\angle DOC=\theta$, $\angle OCD=\varphi$.

$$\text{Then } y = \sqrt{(c^2+x^2-2cx\cos\theta)}, \quad c = \frac{a(m_1-m_2)}{2(m_1+m_2)}.$$

$$c = y\cos\varphi + x\cos\theta. \quad \therefore \cos\varphi = \frac{c-x\cos\theta}{y}.$$

Force acting on $D = (m_1+m_2)/y^2$.

Resolving this force, the component along OD



$$= (m_1+m_2) \cos(\theta+\varphi) / y^2 = \frac{m_1+m_2}{y^3} \{ (c-x\cos\theta) \cos\theta - \sin\theta \sqrt{[y^2-(c-x\cos\theta)^2]} \}$$

$$= \frac{(m_1+m_2)(c\cos\theta-x)}{(c^2+x^2-2cx\cos\theta)^{\frac{3}{2}}}.$$

$$\text{Work} = (m_1+m_2) \int_0^r \frac{(c\cos\theta-x)dx}{(c^2+x^2-2cx\cos\theta)^{\frac{3}{2}}}$$

$$= (m_1+m_2) \left(\frac{1}{\sqrt{(c^2+r^2-2cr\cos\theta)}} - \frac{1}{c} \right)$$

$$= 2(m_1+m_2)^2 \left(\frac{1}{\sqrt{4r^2(m_1+m_2)^2 + a^2(m_1-m_2)^2 - 4ar(m_1^2-m_2^2)\cos\theta}} \right.$$

$$\left. - \frac{1}{m_1-m_2} \right).$$